

# Electrons Dissolved in Water: What color are they?

David M. Bartels and Charles D. Jonah

Electrons become "solvated" in water, as the water molecules orient to stabilize the excess negative charge in a cavity or void space. These "hydrated electrons" can last for milliseconds at room temperature, and while they exist they move and react like other chemical species. The properties and reactions of these powerful reducing agents are important in aqueous radiation environments like nuclear power plant cooling water, or in the radiation treatment of food or drinking water.

In a study of radiation-induced reactions in high temperature and supercritical water using the Argonne Chemistry Division picosecond linac, absorption spectra of hydrated electrons have been measured at high temperatures and pressures as illustrated in Figure 1.

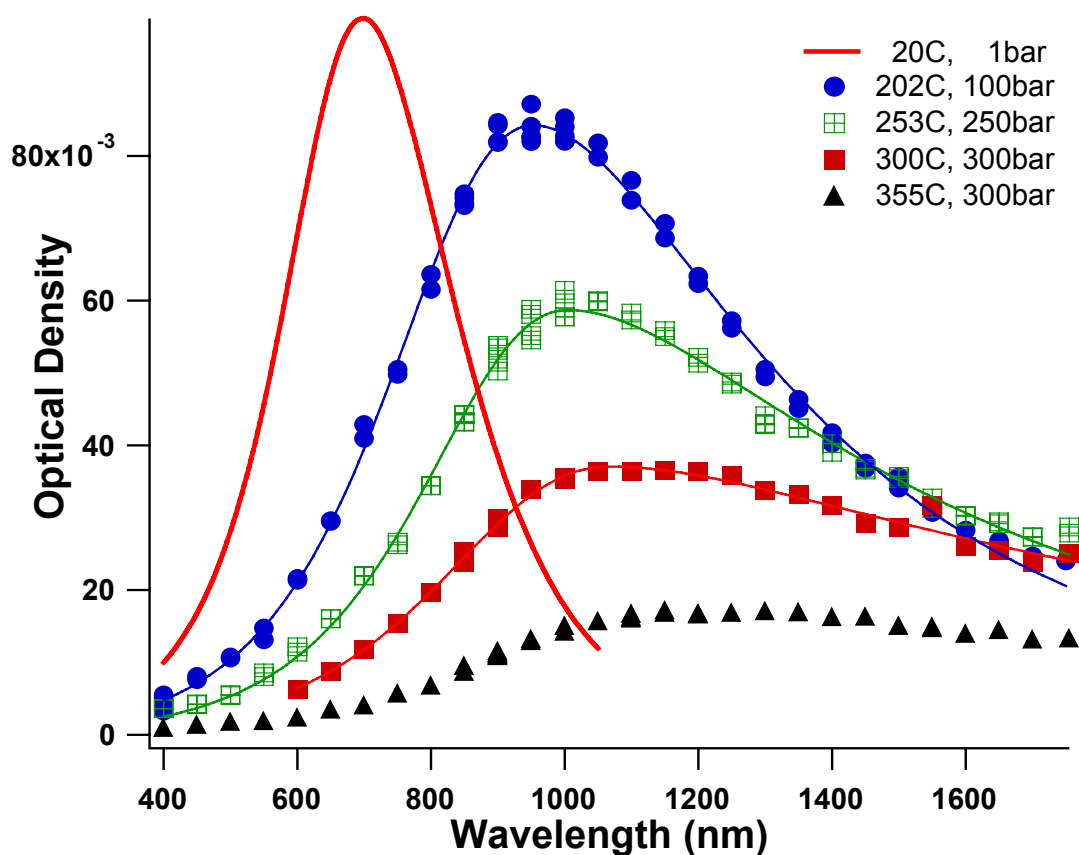


Figure 1. Optical absorption spectra of hydrated electrons in high temperature water.

The spectrum shifts strongly into the near infrared as the temperature is raised. Straightforward application of quantum mechanics tells us the electrons are "bound" less strongly, and the average volume that they occupy increases at higher temperatures. Both properties are important for understanding and predicting their reactions.

What color are electrons dissolved in water? At room temperature they look blue because they absorb all of the incident red light. At higher temperatures they become green and yellow because of the absorption shift to the infrared. But you have to look very quickly to see them.